George B. F. Yee, Reg. No. 37,478
Telephone: 650-326-2400
Inventors: Augustus K. Uht et al.
Title: Automatic and Transparent Hardware Conversion of
Traditional Control Flow to Predicates
Replacement drawing, Sheets of drawings 1 of 5

DISJOINT   NESTED   OVERLAPPED

FIG. 1

"stack"-
(associative
memory)

match

Main
Memory

	v	p	TA
B_6	1	P6	1200
B_4	0	P4	800
B_2	1	P2	1000

1000

ilptr

address
data

$P_{Instr.}$

| P10 | | cp₂ | (opcode, addresses, ...) |

cp_T

new I at 1000 (being loaded)

P10 P_r

Instruction
Window

Key:
v - valid entry
p - predicate address
TA - Target Address
P_r - region predicate
cp_T - Targeting
cancelling-predicate

Snapshot taken at t = 9+ of Example 5.
-new I matches target address in stack

FIG. 2

load time	address	code		stack $\underline{B}$ | v | p_I | TA	predicate-assignment (at load time) $p_{in}=p_r$	cp_{in}	predicate-use (at code execution time) p_{out}	cp_{out}	p_I - condition for I execution
1	100	I_1	$z = x \, op \, y$	empty	1	0	$p_1=1$	-	1
2	200	B_2	if (bc_2) goto 400	B_2 | 1 | P_2 | 400	1	0	$p_2=\overline{bc}_2$	bc_2	1
3	300	I_3		B_2 | 1 | P_2 | 400	P_2	0	-	-	$\overline{bc}_2$
4	400	I_4		empty	P_2	cp_2	$\overline{bc}_2+bc_2$	-	$\overline{bc}_2+bc_2=1$
5	500	I_5		empty	P_4	0	-	-	$p_4=1$
6	600	B_6	if (bc_6) goto 800	B_6 | 1 | P_6 | 800	P_4	0	$\overline{bc}_6 \cdot p_4$	$bc_6 \cdot p_4$	1
7	700	I_7		B_6 | 1 | P_6 | 800	P_6	0	-	-	$\overline{bc}_6$
8	800	I_8		empty	P_6	cp_6	$\overline{bc}_6+bc_6$	-	$\overline{bc}_6+bc_6=1$
9	900	I_9		empty	P_8	0	-	-	$p_6=1$

Equations - for "T": $p_1=p_{out}=p_{in}+cp_{in}$; for "B": $p_{out}=\overline{bc}\cdot p_{in}$; $cp_{out}=bc\cdot p_{in}$

FIG. 3

load time	address	code		stack B v_l p_l TA	predicate-assignment (at load time) $p_{in}=p_r$	cp_{in}	predicate-use (at code execution time) p_{out}	cp_{out}	p_l - condition for I execution
1	100	I_1	$z = x\ op\ y$	empty	1	0	$p_1=1$	-	1
2	200	B_2	if (bc_2) goto 800	B_2 [1 | P_2 | 800]	1	0	$p_2=\overline{bc_2}$	bc_2	1
3	300	I_3		B_2 [1 | P_2 | 800]	P_2	0	-	-	$\overline{bc_2}$
4	400	B_4	if (bc_4) goto 600	B_4 [1 | P_4 | 600], B_2 [1 | P_2 | 800]	P_2	0	$\overline{bc_4}+p_2$	$bc_4 \cdot p_2$	1
5	500	I_5		B_4 [1 | P_4 | 600], B_2 [1 | P_2 | 800]	P_4	0	-	-	$\overline{bc_2} \cdot \overline{bc_4}$
6	600	I_6		B_4 [1 | P_4 | 600], B_2 [1 | P_2 | 800]	P_4	cp_4	$p_6 \cdot cp_4$	$\overline{bc_4} \cdot \overline{bc_2} + bc_4 \cdot bc_2 = bc_2$	
7	700	I_7		B_2 [1 | P_2 | 800]	P_6	0	-	-	$\overline{bc_2}$
8	800	I_8		B_2 [1 | P_2 | 800]	P_6	cp_2	p_6+cp_2	-	$\overline{bc_2}+bc_2=1$
9	900	I_9		empty	P_8	0	-	-	1

Equations - for "T": $p_l=p_{out}=p_{in}+cp_{in}$; for "B": $p_{out}=\overline{bc} \cdot p_{in}$; $cp_{out}=bc \cdot p_{in}$
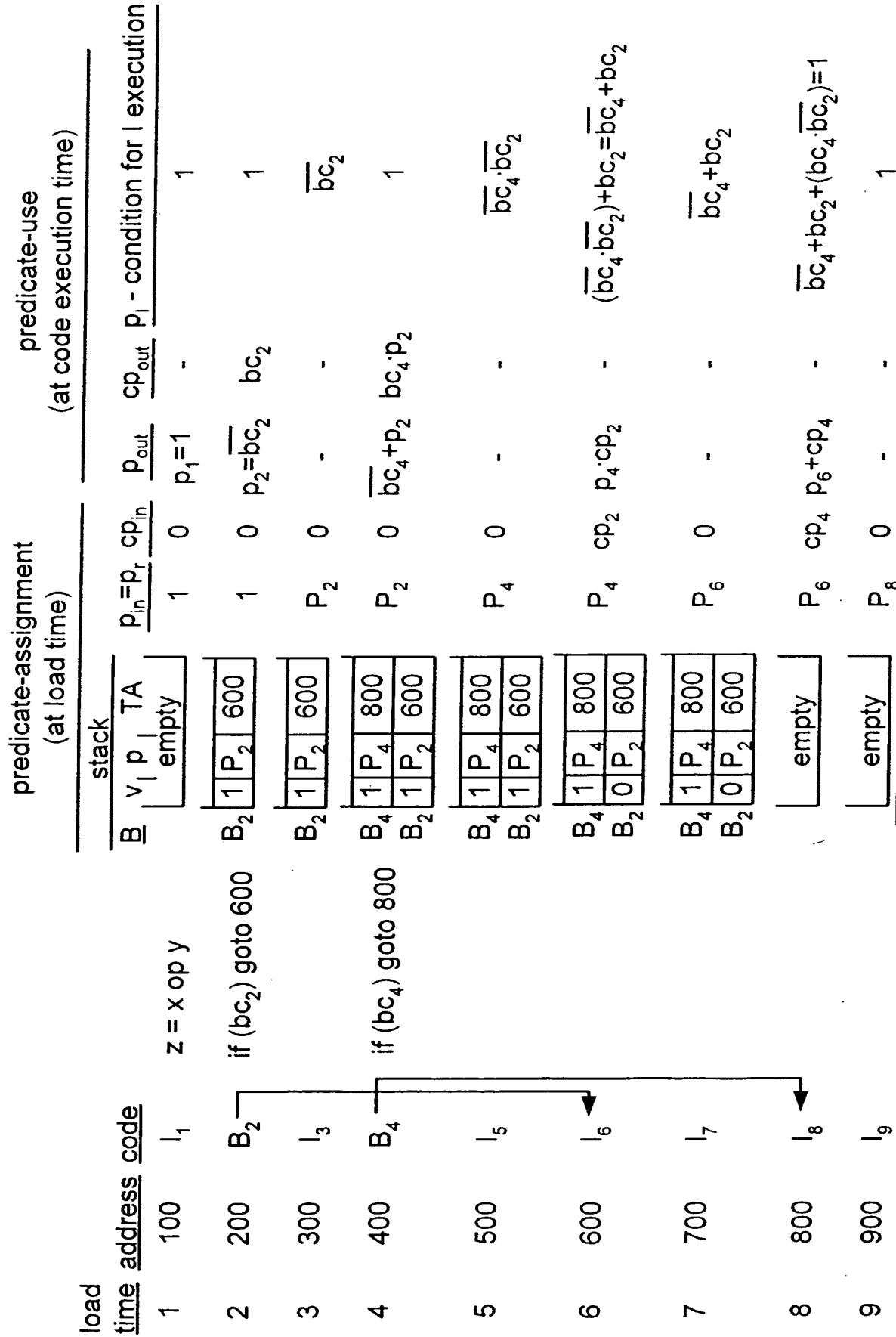
FIG. 4

load time	address	code			stack $\underline{v_l \; p_l \; TA}$	predicate-assignment (at load time) $p_{in}=p_r$	cp_{in}	p_{out}	cp_{out}	predicate-use (at code execution time) p_l - condition for I execution
1	100	I_1	$z = x \; op \; y$		empty	1	0	$p_1=1$	-	1
2	200	B_2	if (bc_2) goto 600	B_2	$1 \mid P_2 \mid 600$	1	0	$p_2=\overline{bc_2}$	bc_2	1
3	300	I_3		B_2	$1 \mid P_2 \mid 600$	P_2	0	-	-	$\overline{bc_2}$
4	400	B_4	if (bc_4) goto 800	B_4	$1 \mid P_4 \mid 800$	P_2	0	$\overline{bc_4}+p_2$	$bc_4 \cdot p_2$	1
				B_2	$1 \mid P_2 \mid 600$					
5	500	I_5		B_4	$1 \mid P_4 \mid 800$	P_4	0	-	-	$\overline{bc_4 \cdot \overline{bc_2}}$
				B_2	$1 \mid P_2 \mid 600$					
6	600	I_6		B_4	$1 \mid P_4 \mid 800$	P_4	cp_2	$p_4 \cdot cp_2$	-	$(\overline{bc_4 \cdot \overline{bc_2}})+bc_2=\overline{bc_4}+bc_2$
				B_2	$0 \mid P_2 \mid 600$					
7	700	I_7		B_4	$1 \mid P_4 \mid 800$	P_6	0	-	-	$\overline{bc_4}+bc_2$
				B_2	$0 \mid P_2 \mid 600$					
8	800	I_8			empty	P_6	cp_4	p_6+cp_4	-	$\overline{bc_4}+bc_2+(\overline{bc_4 \cdot \overline{bc_2}})=1$
9	900	I_9			empty	P_8	0	-	-	1

Equations - for "T": $p_1=p_{out}=p_{in}+cp_{in}$; for "B": $p_{out}=\overline{bc}\cdot p_{in}$; $cp_{out}=bc\cdot p_{in}$

FIG. 5

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load time	address	code		stack (B, v, p, TA)	$p_{in}=p_r$	cp_{in}	p_{out}	cp_{out}	p_I - condition for I execution
				predicate-assignment (at load time)			**predicate-use (at code execution time)**		
1	100	I_1	z = x op y	empty	1	0	$p_1=1$	-	1
2	200	B_2	if (bc_4) goto 800	B_2 | 1 | P_2 | 1000	1	0	$p_2=\overline{bc_2}$	bc_2	1
3	300	I_3		B_2 | 1 | P_2 | 1000	P_2	0	-	-	$\overline{bc_2}$
4	400	B_4	if (bc_4) goto 800	B_4 | 1 | P_4 | 800 / B_2 | 1 | P_2 | 1000	P_2	0	$\overline{bc_4}+p_2$	$bc_4\,p_2$	1
5	500	I_5		B_4 | 1 | P_4 | 800 / B_2 | 1 | P_2 | 1000	P_4	0	-	-	$\overline{bc_4}\cdot\overline{bc_2}$
6	600	B_6	if (bc_6) goto 1200	B_6 | 1 | P_6 | 1200 / B_4 | 1 | P_4 | 800 / B_2 | 1 | P_2 | 1000	P_4	0	$\overline{bc_6}\cdot p_4$	$bc_6\cdot p_4$	1
7	700	I_7		B_6 | 1 | P_6 | 1200 / B_4 | 1 | P_4 | 800 / B_2 | 1 | P_2 | 1000	P_6	0	-	-	$\overline{bc_6}\cdot\overline{bc_4}\cdot\overline{bc_2}$
8	800	I_8		B_6 | 1 | P_6 | 1200 / B_4 | 0 | P_4 | 800 / B_2 | 1 | P_2 | 1000	P_6	cp_4	p_6+cp_4	-	$(\overline{bc_6}\cdot\overline{bc_4}\cdot\overline{bc_2})+(bc_4\cdot\overline{bc_2})$ $=(\overline{bc_6}+bc_4)\overline{bc_2}$
9	900	I_9		B_6 | 1 | P_6 | 1200 / B_4 | 0 | P_4 | 800 / B_2 | 1 | P_2 | 1000	P_8	0	-	-	$(\overline{bc_6}+bc_4)\overline{bc_2}$
10	1000	I_{10}		B_6 | 1 | P_6 | 1200	P_8	cp_2	p_8+cp_2	-	$((\overline{bc_6}+bc_4)\overline{bc_2})+bc_2$ $=\overline{bc_6}+bc_4+bc_2$
11	1100	I_{11}		B_6 | 1 | P_6 | 1200	P_{10}	0	-	-	$(\overline{bc_6}+bc_4)bc_2$
12	1200	I_{12}		empty	P_{10}	cp_6	$p_{10}+cp_6$	-	$bc_6+bc_4+bc_2+$ $(bc_6\cdot bc_4\cdot bc_2)=1$
13	1300	I_{13}		empty	P_{12}	0	-	-	1

Equations - for "T": $p_1=p_{out}=p_{in}+cp_{in}$; for "B": $p_{out}=\overline{bc}\cdot p_{in}$; $cp_{out}=bc\cdot p_{in}$

FIG. 6